MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

EME2056 – THEORY OF MACHINES
(All sections)

31 MAY 2017
09:00 a.m – 11:00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 7 pages including cover page with 5 Questions and 1 appendix.

2. Attempt **FOUR** out of **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

Figure Q1 shows a mechanism which is used to crush rock. If the crank of the mechanism is rotating at a rate of 60 rpm clockwise and decelerating at a rate of 10 rad/s^2, determine the angular velocity and acceleration of the crushing ram at the instant shown.

[12+13 marks]

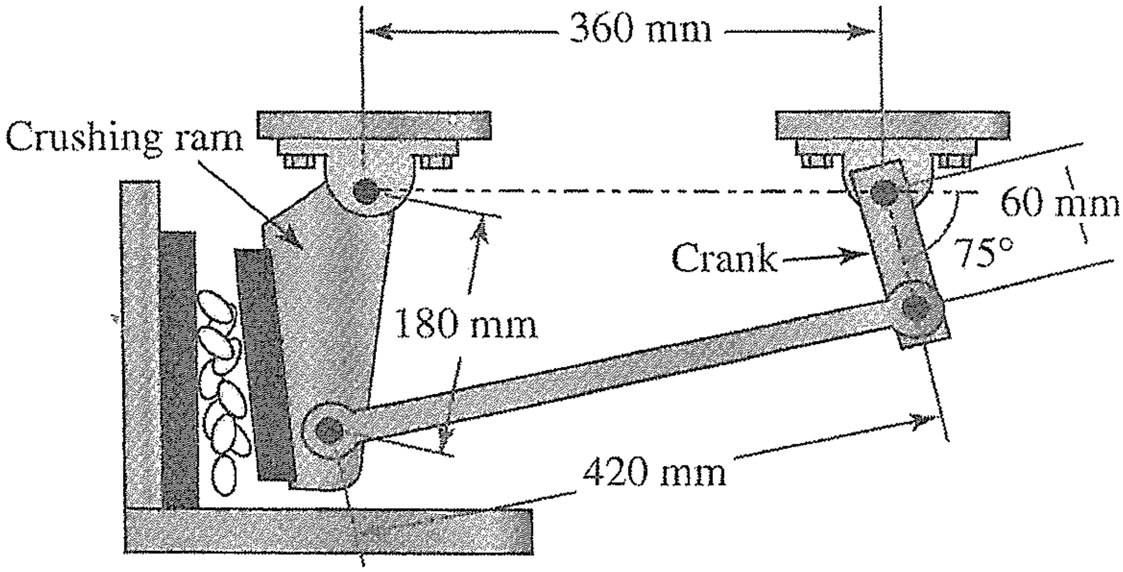


Figure Q1

Continued ....

Question 2

Figure Q2 shows a small hydraulic jack. At the instant shown in the figure, a 45 N force is applied to the handle. This cause the 8.89-cm link to rotate clockwise at a constant rate of 5 rad/s. The weights of all moving parts except the 6.7-N piston are to be neglected. Determine the pin forces and the force acting on the piston due to the hydraulic fluid.

[25 marks]

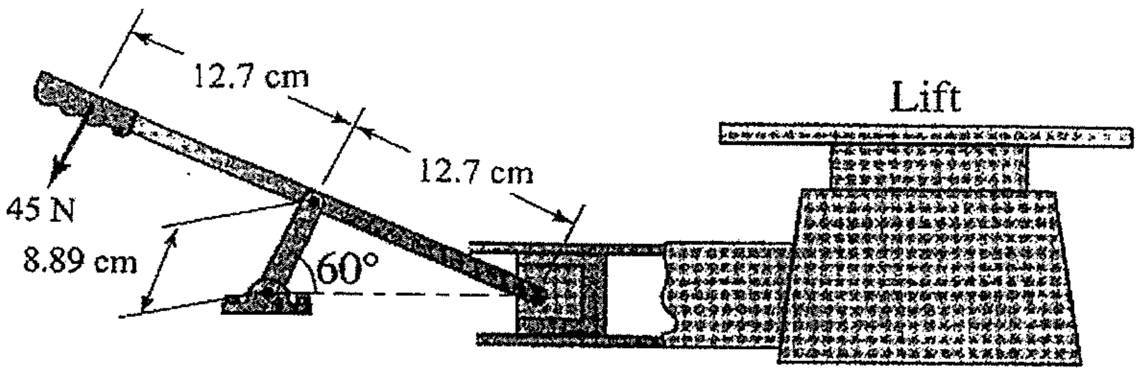


Figure Q2

Continued ....

Question 3

A cam drive is used for a mechanism that packs stuffing into shipping boxes. The cam which is rotating clockwise is required to give its translating roller follower the following sequential motion:

i. rise outward 50 mm with cycloidal motion in 0.7 second.
ii. dwell for 0.2 second.
iii. fall 25 mm with harmonic motion in 0.5 second.
iv. dwell for 0.2 second.
v. fall with harmonic motion in 0.5 second

The follower is placed vertically in the top of the cam. The offset distance is 20 mm to the left of the cam center. The roller diameter of the follower is 20 mm. The base-circle diameter of the cam is to be 60 mm.

(a) Determine the speed of the cam

[2 marks]

(b) Draw the follower displacement diagram.

[10 marks]

(c) Graphically lay out the profile of a disk cam that will cause the follower to exhibit the sequential motion as specified above.

[13 marks]

Continued ....

Question 4

Figure Q4 shows an epicyclic gear train in which the wheel D is held stationary by the shaft A and the arm B is rotated at 200 rpm. The wheels E and F are fixed together and rotate freely on the shaft carried by the arm B. The wheel G is rigidly attached to the shaft C. Find the speed of the shaft C, stating the direction of rotation relative to that of B. The numbers of teeth are as follows: E, 20; F, 40; G, 30.
If the gear train is required to transmit 7.5 kW, what will be the torque required to hold the shaft A stationary if all frictional losses are neglected.

[16+9 marks]

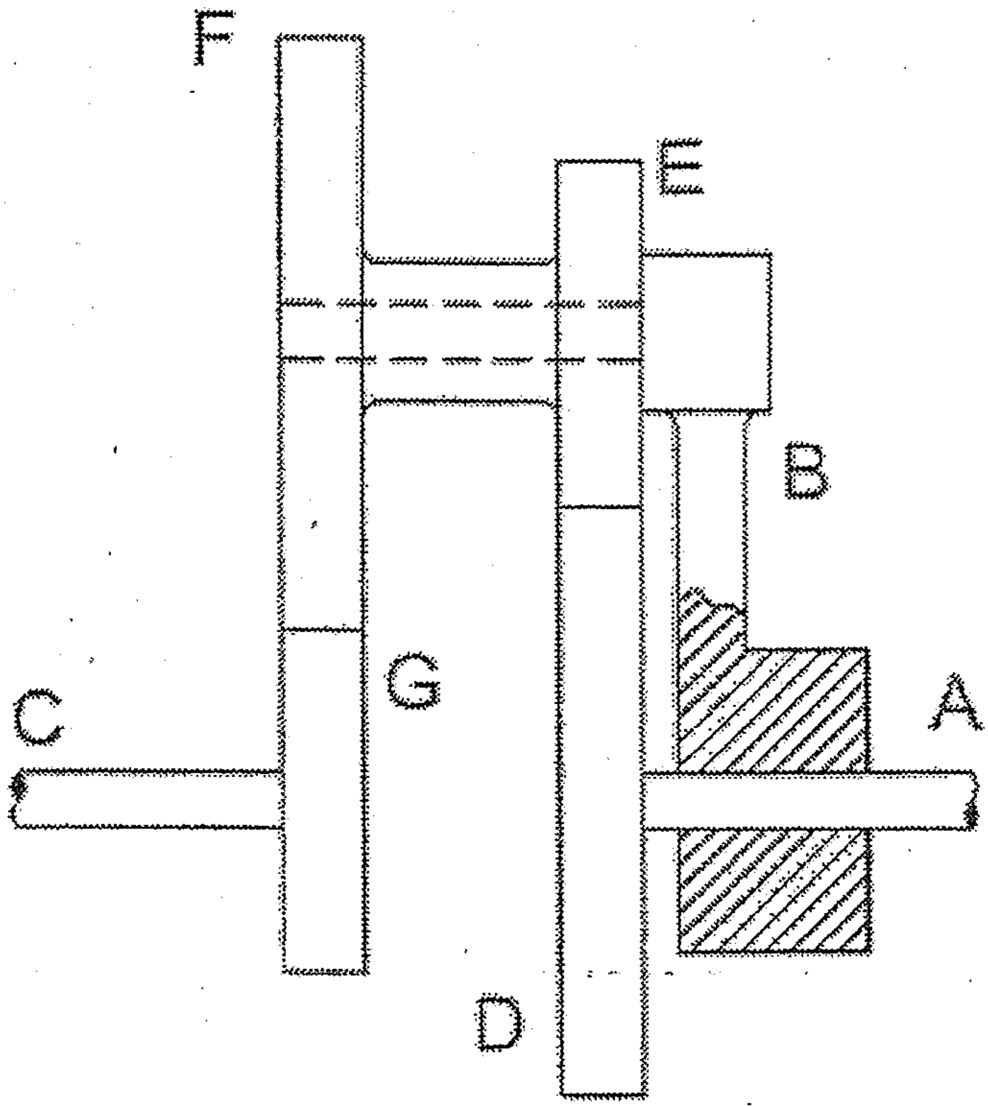


Figure Q4

Continued ....

Question 5

Three rotating masses, $A = 14\text{ kg}$, $B = 11\text{ kg}$, and $C = 21\text{ kg}$, are attached to a shaft with their centers of gravity at 55 mm, 80 mm and 30 mm respectively from the shaft axis. The angular positions of B and C from A are respectively 60^0 and 130^0 measured in the same direction. The distance between the planes of rotation of A and B is 1.5 m and between B and C is 2.5 m in the same direction as shown in the Figure Q5. Determine the magnitudes and angular positions with respect to A of the two balance masses D and E, each with its center of gravity at 45 mm from the shaft axis, to be attached in planes midway between A and B and between B and C by making the plane between A and B as reference.

[13+12 marks]

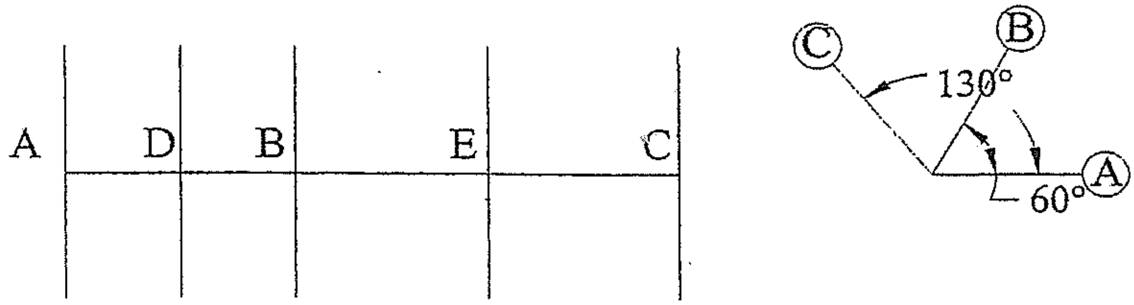
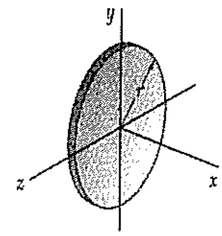
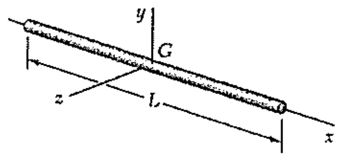
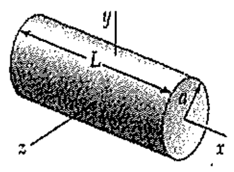
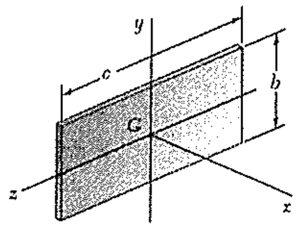
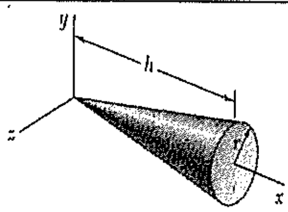
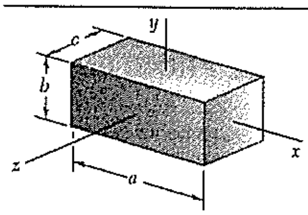
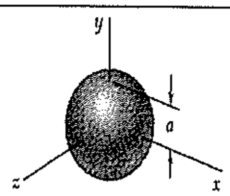


Figure Q5

Continued ....

Appendix: Mass Moment of Inertia of Homogenous Solids

	$I_x = \frac{1}{2}mr^2$ $I_y = I_z = \frac{1}{4}mr^2$		$I_y = I_z = \frac{1}{12}mL^2$
	$I_x = \frac{1}{2}ma^2$ $I_y = I_z = \frac{1}{12}m(3a^2 + L^2)$		$I_x = \frac{1}{12}m(b^2 + c^2)$ $I_y = \frac{1}{12}mc^2$ $I_z = \frac{1}{12}mb^2$
	$I_x = \frac{3}{10}ma^2$ $I_y = I_z = \frac{3}{5}m(\frac{1}{4}a^2 + h^2)$		$I_x = \frac{1}{12}m(b^2 + c^2)$ $I_y = \frac{1}{12}m(c^2 + a^2)$ $I_z = \frac{1}{12}m(a^2 + b^2)$
	$I_x = I_y = I_z = \frac{2}{5}ma^2$		

Mass Moment of Inertia based on radius of gyration

$I = mk^2$, $m =$ mass of the body, $k =$ radius of gyration

End of Paper